CLAIM AMENDMENTS

Amended claims: 1, 3, 6, 14, 16, 18, 21 and 23. Cancelled claims: 4, 5, 7, 9, 10, 12, 15, 17, 19, 20 and 22. Added new claims 24-30

1. (Currently Amended) A flameless distributed combustion heated~~,~~ membrane~~,~~ steam reforming reactor comprising:

a) a reforming chamber containing a reforming catalyst bed, said reforming chamber having an inlet for vaporizable hydrocarbon and steam, a flow path for hydrogen and by-product gases resulting from the reforming reactions taking place in said reforming chamber and an outlet for said by-product gases,

b) at least one flameless distributed combustion chamber in a heat transferring relationship with said reforming catalyst bed whereby a distributed, controlled heat flux is provided by said flameless distributed combustion chambers(s) to said reforming catalyst bed, said flameless distributed combustion chamber(s) comprising an inlet and a flow path for an oxidant, an outlet for combustion gas and further comprising a fuel conduit having an inlet for fuel and a plurality of fuel nozzles which provide fluid communication from within the fuel conduit to the flow path of said oxidant, said plurality of fuel nozzles being sized and spaced along the length of said fuel conduit so that no flame results when said fuel is mixed with said oxidant in said flameless distributed combustion chamber;

c) a preheater capable of preheating said oxidant to a temperature that when said fuel and said oxidant are mixed in said flameless distributed combustion chamber, the temperature of the resulting mixture of said oxidant and fuel exceeds the autoignition temperature of said mixture; and

d) at least two hydrogen-selective, hydrogen-permeable, membrane tubes in contact with said reforming catalyst bed, each of said membrane tubes having an outlet whereby hydrogen formed in the reforming chamber permeates into said membrane tube and passes through said outlet.

2. (Original) A process for the production of hydrogen, comprising:

a) reacting steam with a vaporizable hydrocarbon at a temperature of from about 200°C to about 700°C and at a pressure of from about 1 bar to about 200 bar in a reaction zone containing a reforming catalyst to produce a mixture of primarily hydrogen and carbon dioxide, with a lesser amount of carbon monoxide;

b) providing heat to said reaction zone by employing at least one flameless distributed combustion chamber thereby driving said reaction; and

c) conducting said reaction in the vicinity of at least two hydrogen-permeable, hydrogen-selective membrane tubes, whereby hydrogen formed in said reaction zone permeates through said hydrogen selective membrane tubes and is separated from said carbon dioxide and carbon monoxide.

3. (Currently Amended) A membrane~~,~~ steam reforming reactor comprising:

a) a reforming chamber containing a reforming catalyst bed, said reforming chamber having an inlet for vaporizable hydrocarbon and steam, a flow path for hydrogen and by-product gases resulting from the reforming reactions taking place in said reforming chamber and an outlet for said by-product gases,

b) at least one flameless distributed combustion chamber in a heat transferring relationship with said reforming catalyst bed,

and

c) at least two hydrogen-selective, hydrogen-permeable, membrane tubes in contact with said reforming catalyst bed, ~~and~~ wherein at least one of the membrane tubes is ~~also~~ connected to a section containing a metal hydride precursor, and wherein the hydrogen formed in the reforming chamber permeates through said membrane tube to said section containing the metal hydride precursor which reacts with the permeated hydrogen to form hydride.

4. (Cancelled)

5. (Cancelled)

6. (Currently Amended) ~~A~~ The hydrogen fuel cell, wherein the hydrogen feed is made by a process as described in claims 2 ~~or 5~~.

7. (Cancelled).

8. (Currently Amended) The ~~reactor,~~ process ~~or fuel cell~~ of claims ~~1,~~ 2, ~~3, 4, 5, 6, or 7,~~ wherein said catalyst bed is in heat transferring contact with multiple flameless distributed combustion chambers.

9. (Cancelled).

10. (Cancelled).

11. (Currently Amended) The ~~reactor,~~ process ~~or fuel cell~~ of claims 2, ~~1-8,~~ wherein a sweep gas is used to promote the diffusion of hydrogen through at least one of said membrane tubes, said sweep gas being selected from the group consisting of steam, carbon dioxide, nitrogen and condensable hydrocarbon and the vaporizable hydrocarbon is selected from the group consisting of natural gas, methane, ethyl benzene, methanol, ethane, ethanol, propane, butane, light hydrocarbons having 1-4 carbon atoms in each molecule, light petroleum fractions including naphtha, diesel, kerosene, jet fuel or gas oil, and hydrogen, carbon monoxide and mixtures thereof.

12. (Cancelled).

13. (Currently Amended) The reactor, ~~process or fuel cell~~ of claims 1, ~~12~~ wherein said catalyst bed contains baffles in a form selected from the group consisting of (i) washers and disks, and (ii) truncated disks.

14. (Currently Amended) The reactor, ~~process or fuel cell~~ of claims 1-~~13~~, wherein the hydrogen-selective and at least one of the hydrogen-permeable membranes is made of a Pd-alloy layer supported on a porous metal, particularly a Pd-alloy layer deposited by electroless plating on porous metal with an in-situ oxide protection layer.

15. (Cancelled).

16. (Currently Amended) The reactor, ~~process or fuel cell~~ of claims ~~1-13~~, wherein at least one of the hydrogen-selective and hydrogen-permeable membranes has a ratio of length to diameter of less than about 500, gaps between the membrane tubes are from about ¼ inch (about 0.64 cm) to about 2 inches (about 5.08 cm), and gap between the membrane and FDC tubes is from about ¼ inch (about 0.64 cm) to about 2 inches (about 5.08 cm).

17. (Cancelled).

18. (Currently Amended) The reactor, ~~process or fuel cell~~ of claims ~~1-17~~, wherein the FDC chamber ~~having~~ has an external tubular dimension such that the length to diameter ratio is higher than 4.

19. (Cancelled).

20. (Cancelled).

21. (Currently Amended) The ~~reactor or~~ process of claims 2 ~~1-3~~, wherein carbon dioxide produced from said steam reforming chamber has a concentration of from about 80% to about 99% molar dry basis.

22. (Cancelled).

23. (Currently Amended) The ~~reactor,~~ process~~, or fuel cell~~ of claims 2 ~~1-3~~, wherein carbon dioxide produced from~~,~~ said steam reforming chamber is used at least in part for enhanced recovery of oil in oil wells or enhanced recovery of methane in coal bed methane formations.

24. (New) The reactor of claim 1, wherein said catalyst bed is in heat transferring contact with multiple flameless distributed combustion chambers.

25. (New) The reactor of claim 3, wherein said catalyst bed is in heat transferring contact with multiple flameless distributed combustion chambers.

26. (New) The reactor of claim 3, wherein a sweep gas is used to promote the diffusion of hydrogen through at least one of said membrane tubes, said sweep gas being selected from the group consisting of steam, carbon dioxide, nitrogen and condensable hydrocarbon and the vaporizable hydrocarbon is selected from the group consisting of natural gas, methane, ethyl benzene, methanol, ethane, ethanol, propane, butane, light hydrocarbons having 1-4 carbon atoms in each molecule, light petroleum fractions including naphtha, diesel, kerosene, jet fuel or gas oil, and hydrogen, carbon monoxide and mixtures thereof.

27. (New) The reactor of claim 3, wherein said catalyst bed contains baffles in a form selected from the group consisting of (i) washers and disks, and (ii) truncated disks.

28. (New) The reactor of claim 3, wherein the hydrogen-selective and at least one of the hydrogen-permeable membranes is made of a Pd-alloy layer supported on a porous metal, particularly a Pd-alloy layer deposited by electroless plating on porous metal with an in-situ oxide protection layer.

29. (New) The reactor of claim 3, wherein at least one of the hydrogen-selective and hydrogen-permeable membranes has a ratio of length to diameter of less than about 500, gaps between the membrane tubes are from about ¼ inch (about 0.64 cm) to about 2 inches (about 5.08 cm), and gap between the membrane and FDC tubes is from about ¼ inch (about 0.64 cm) to about 2 inches (about 5.08 cm).

30. (New) The reactor of claim 3, wherein the FDC chamber has an external tubular dimension such that the length to diameter ratio is higher than 4.